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(54) Circuit for regulating the output power of a microwave oven

(57) A microwave oven having a magnetron 22 for generating high frequency energy is powered by an inverter 11. The inverter 11 includes a rectifier 2 for rectifying an ac input and a switching element 18 for switching the d.c output from the rectifier. The input current to the inverter 11 is detected 29 and compared with a predetermined current stored in a non-volatile memory 28, so that a microcomputer 23 outputs an ON/OFF signal having a certain ratio. The ON/OFF signal is used to drive the switching element 18 and allows regulation of the microwave output power. The microwave oven also has a circuit (see fig. 4) for transferring sensor signal data stored in the microcomputer into a non-volatile memory upon detection of power failure. The data is transferred back into microcomputer memory when power is restored.

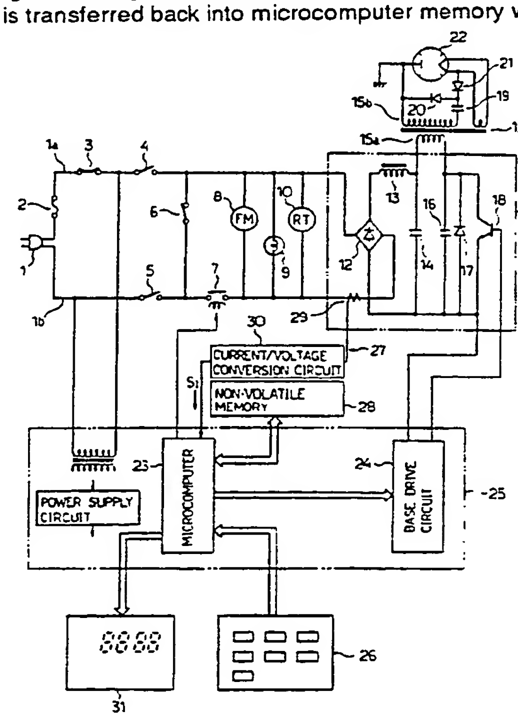
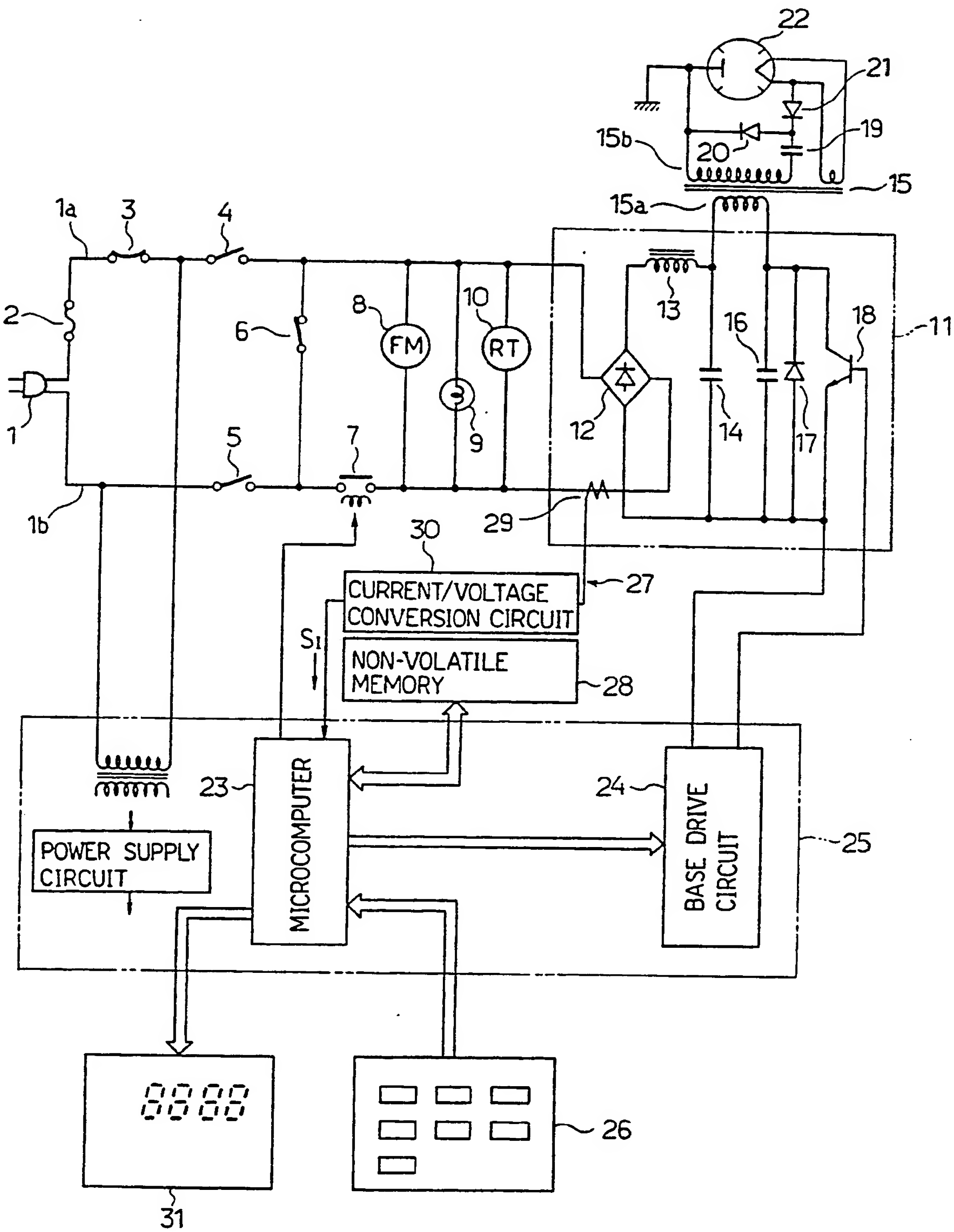


FIG.1

GB 2 239 330 A



22
21
19
15b
20
15
15a
1a
3
4
2
6
8
FM
10
RT
13
16
18
11
1
9
12
14
17
5
7
1b
29
30
27
CURRENT/VOLTAGE CONVERSION CIRCUIT
S1
NON-VOLATILE MEMORY
28
23
MICROCOMPUTER
24
BASE DRIVE CIRCUIT
25
POWER SUPPLY CIRCUIT
26
31

FIG.1

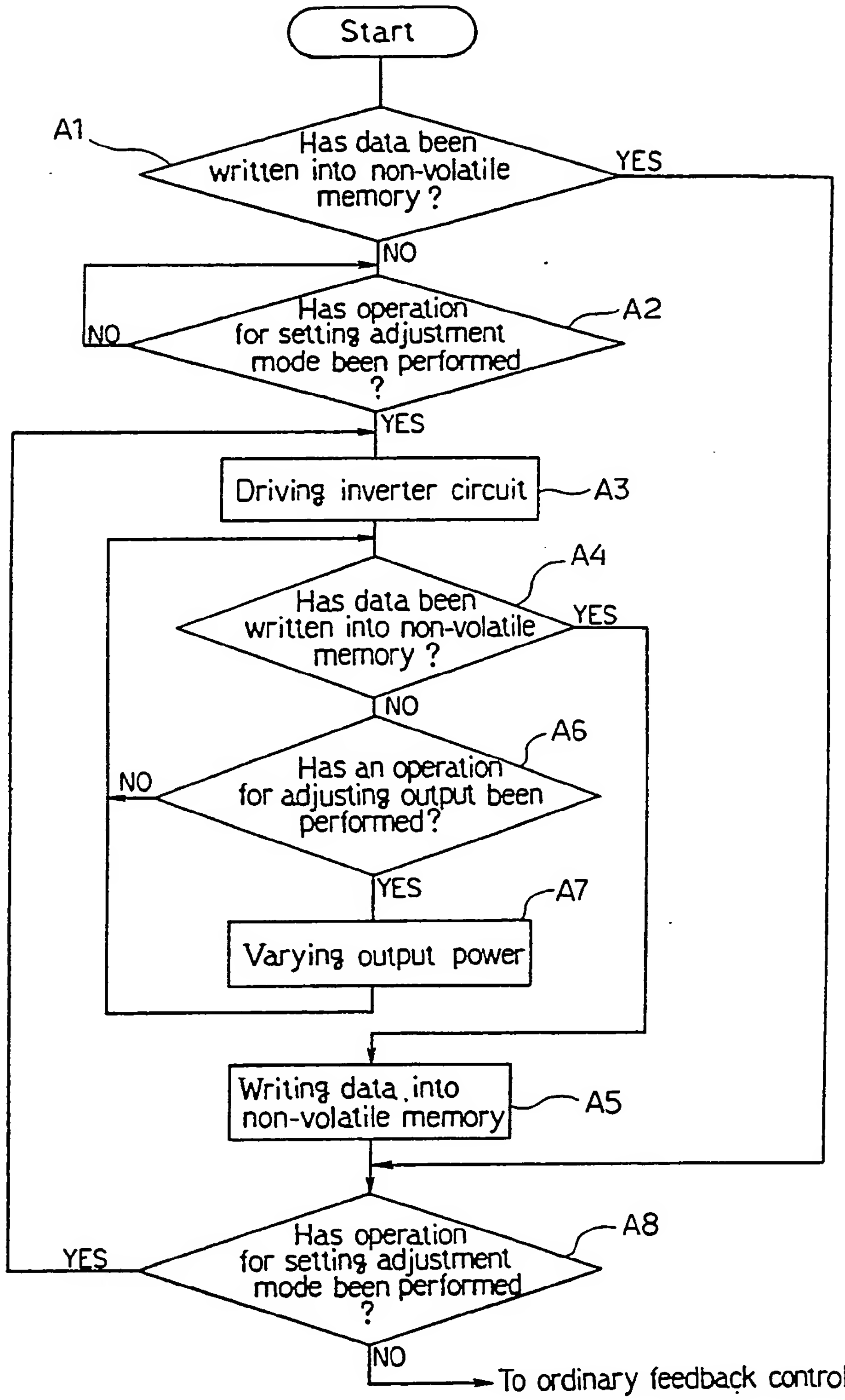
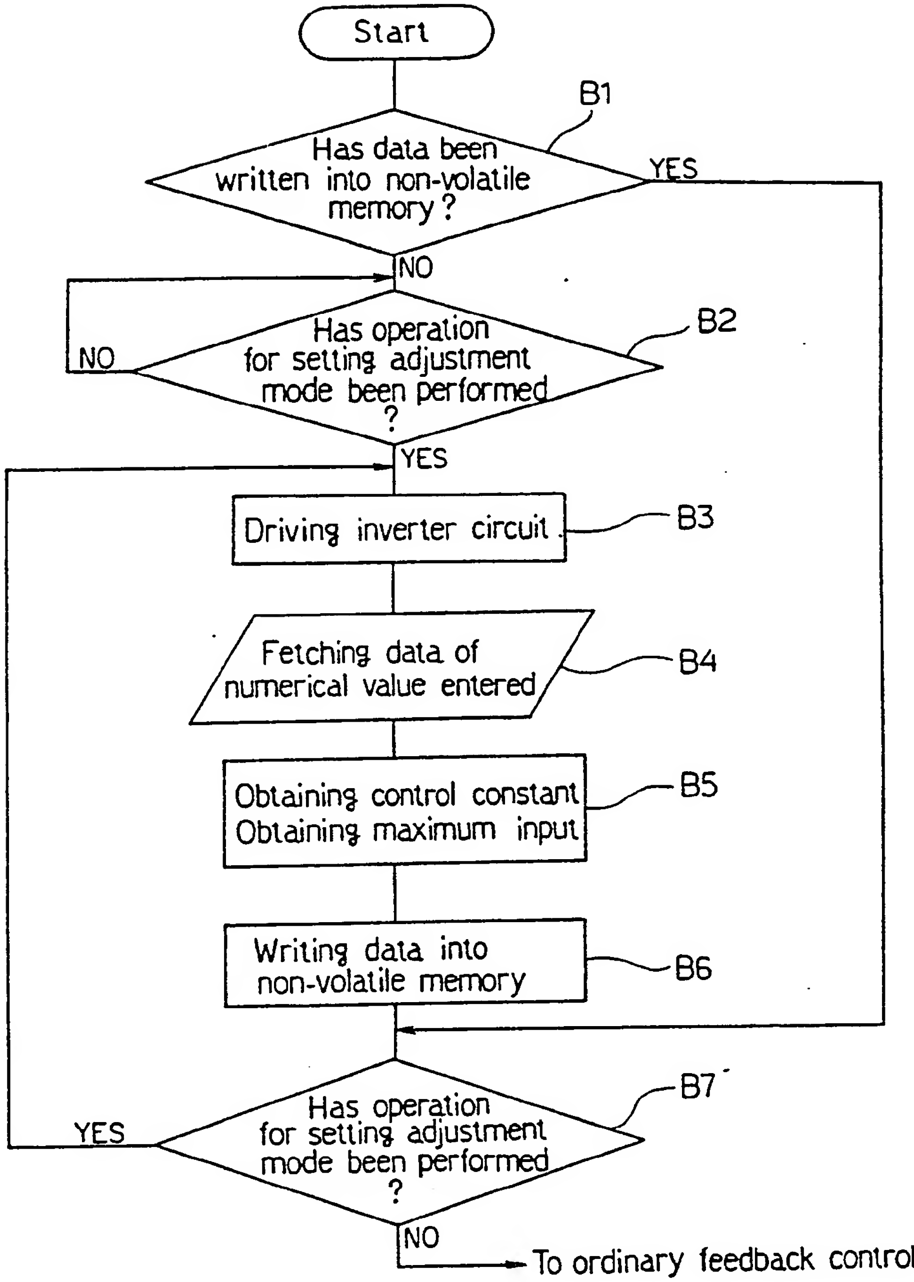

Start
A1
Has data been written into non-volatile memory ?
YES
NO
Has operation for setting adjustment mode been performed ?
A2
NO
YES
Driving inverter circuit
A3
A4
Has data been written into non-volatile memory ?
YES
NO
A6
Has an operation for adjusting output been performed?
NO
YES
A7
Varying output power
Writing data into non-volatile memory
A5
Has operation for setting adjustment mode been performed ?
A8
YES
NO
To ordinary feedback control

FIG. 2



Start
B1
Has data been written into non-volatile memory ?
YES
NO
B2
Has operation for setting adjustment mode been performed ?
NO
YES
Driving inverter circuit
B3
Fetching data of numerical value entered
B4
Obtaining control constant
Obtaining maximum input
B5
Writing data into non-volatile memory
B6
B7
Has operation for setting adjustment mode been performed ?
YES
NO
To ordinary feedback control

FIG.3

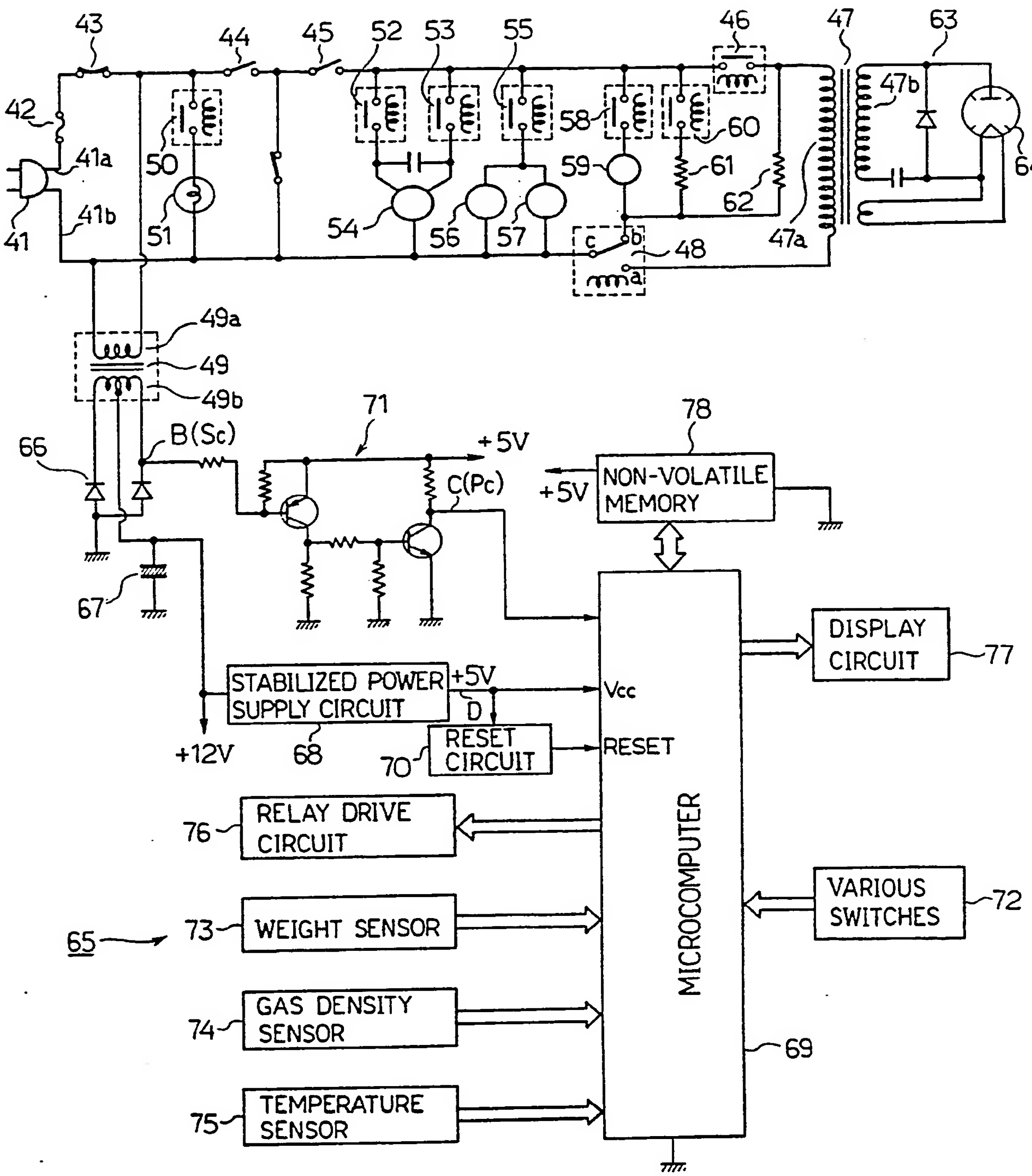

43
44
45
52
53
55
46
47
63
42
41a
50
47b
58
60
59
61
64
62
41b
51
54
56
57
47a
41
c
b
48
a
49a
49
49b
71
78
66
B(Sc)
+5V
C(Pc)
+5V
NON-VOLATILE MEMORY
67
DISPLAY CIRCUIT
77
STABILIZED POWER SUPPLY CIRCUIT
+5V
Vcc
D
+12V
68
70
RESET CIRCUIT
RESET
RELAY DRIVE CIRCUIT
76
MICROCOMPUTER
VARIOUS SWITCHES
72
65
73
WEIGHT SENSOR
GAS DENSITY SENSOR
74
69
TEMPERATURE SENSOR
75

FIG.4

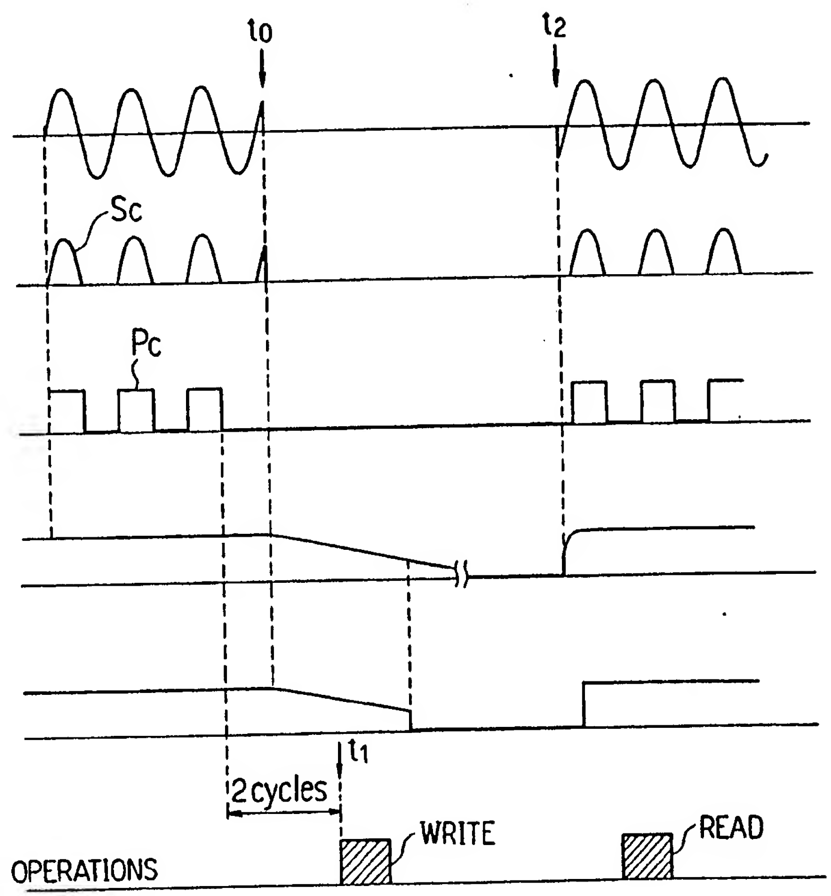


FIG. 5 (a) AC INPUT

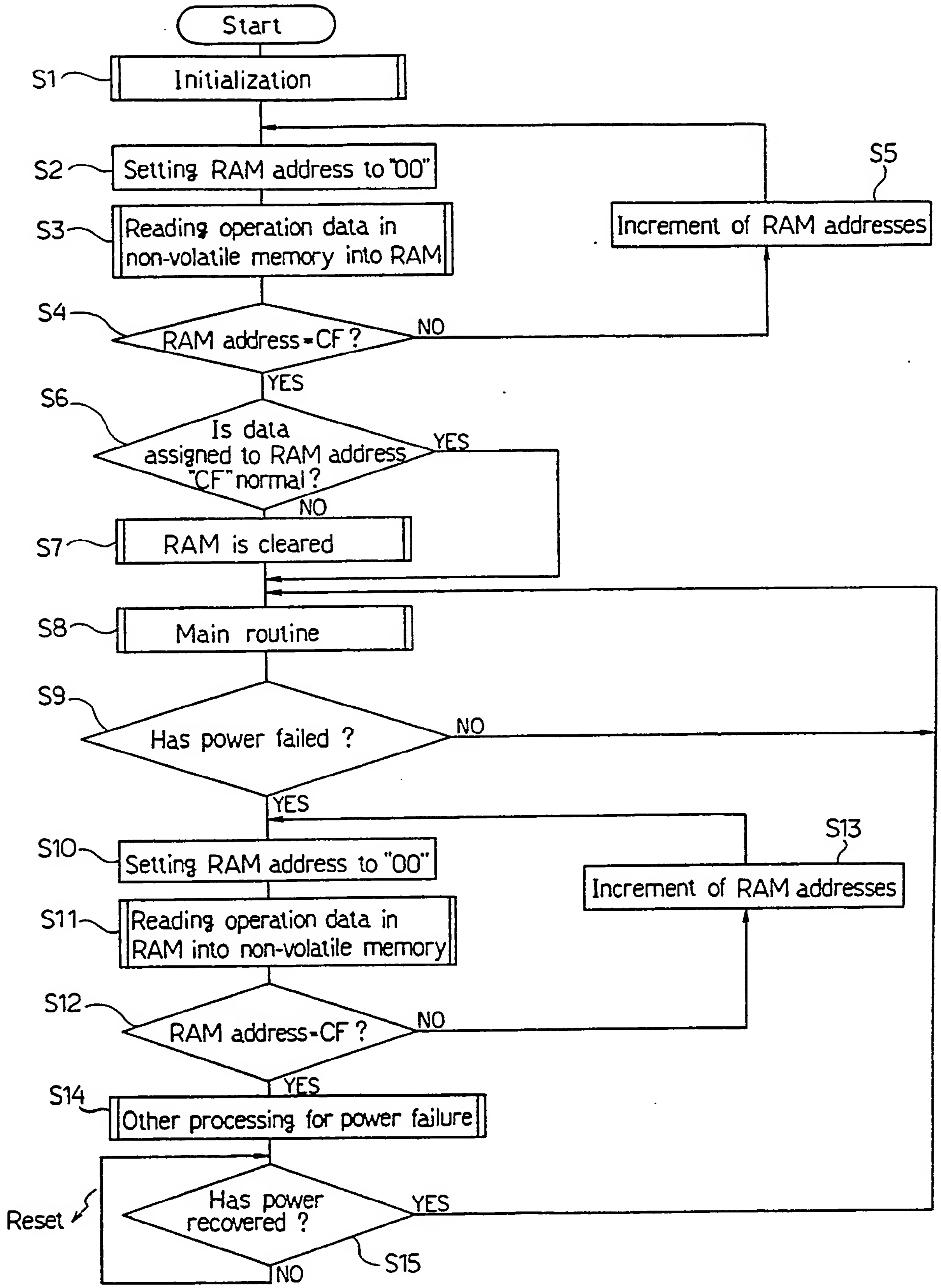
FIG. 5 (b) POINT B

FIG. 5 (c) POINT C

FIG. 5 (d) POINT D

FIG. 5 (e) RESET

FIG. 5 (f) WRITE AND READ OPERATIONS OF MICROCOMPUTER



Start
S1
Initialization
S2
Setting RAM address to "00"
S3
Reading operation data in non-volatile memory into RAM
S4
RAM address=CF ?
NO
YES
S5
Increment of RAM addresses
S6
Is data assigned to RAM address "CF" normal ?
YES
NO
S7
RAM is cleared
S8
Main routine
S9
Has power failed ?
NO
YES
S10
Setting RAM address to "00"
S11
Reading operation data in RAM into non-volatile memory
S12
RAM address=CF ?
NO
YES
S13
Increment of RAM addresses
S14
Other processing for power failure
Reset
Has power recovered ?
YES
NO
S15

FIG.6

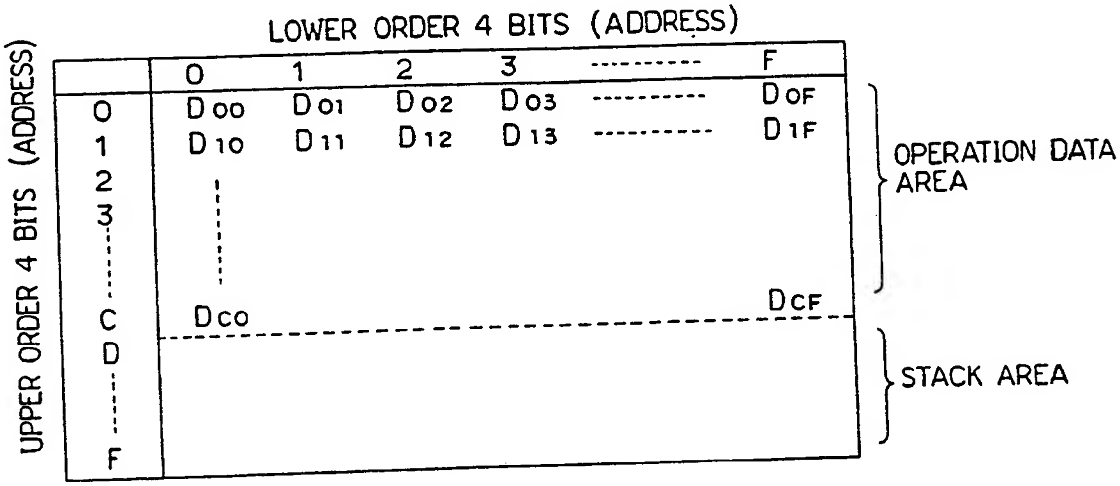
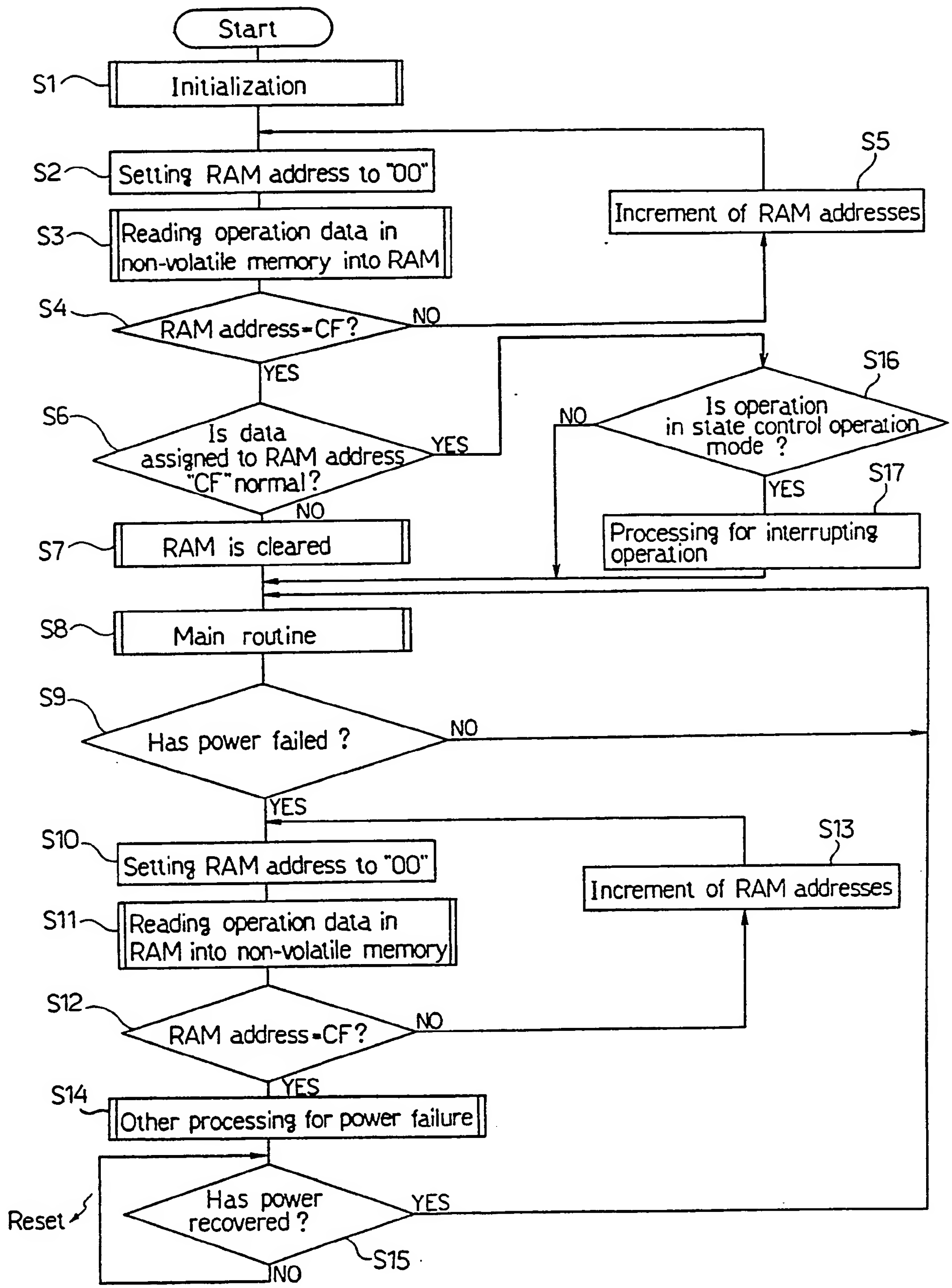
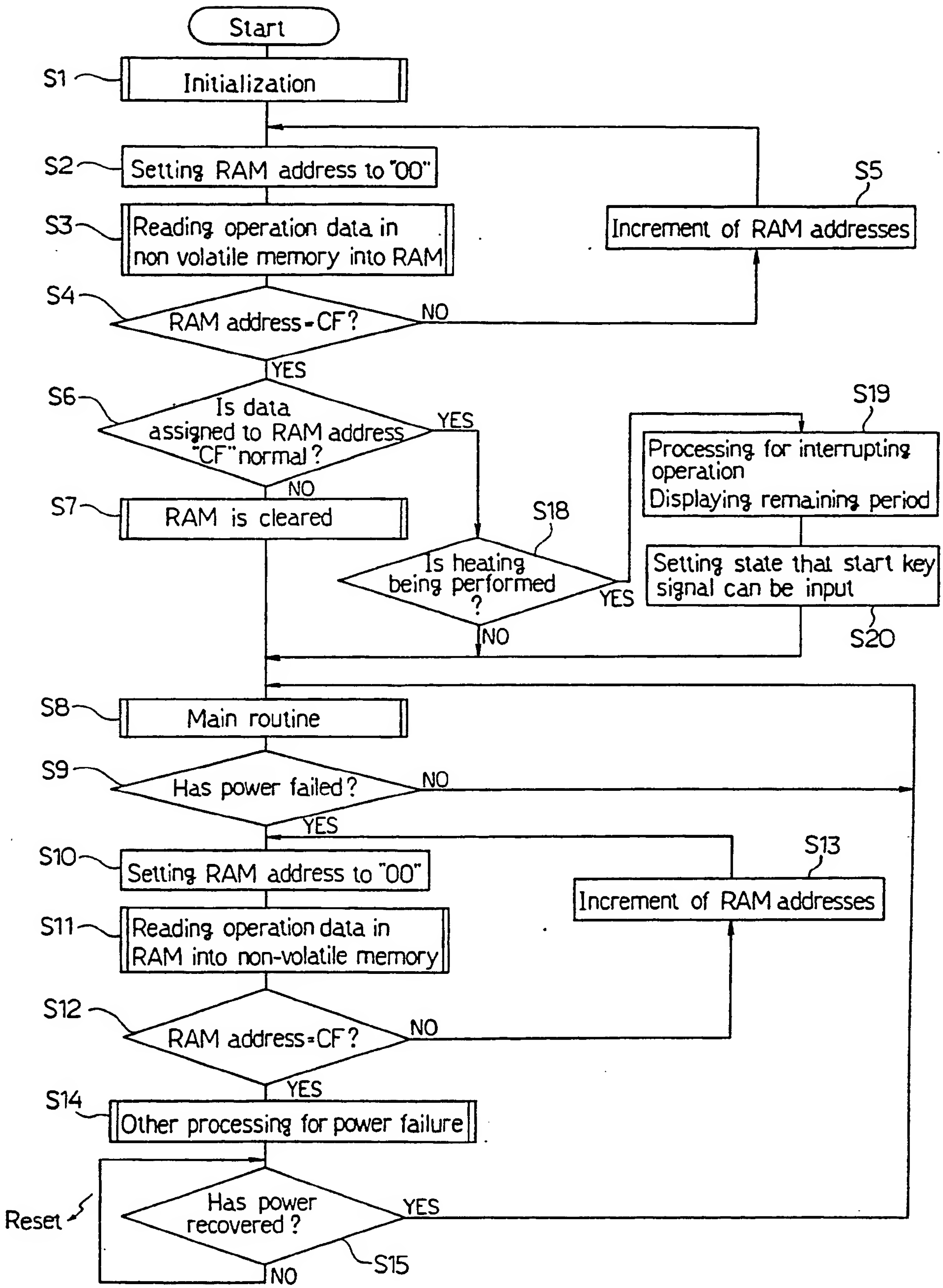

LOWER ORDER 4 BITS (ADDRESS)
UPPER ORDER 4 BITS (ADDRESS)
0
1
2
3
F
0
1
2
3
C
D
F
D00
D01
D02
D03
D0F
D10
D11
D12
D13
D1F
DC0
DCF
OPERATION DATA AREA
STACK AREA

FIG.7



Start
S1
Initialization
S2
Setting RAM address to "00"
S3
Reading operation data in non-volatile memory into RAM
S4
RAM address=CF?
NO
YES
S5
Increment of RAM addresses
S6
Is data assigned to RAM address "CF" normal?
YES
NO
S16
Is operation in state control operation mode ?
NO
YES
S17
Processing for interrupting operation
S7
RAM is cleared
S8
Main routine
S9
Has power failed ?
NO
YES
S10
Setting RAM address to "00"
S13
Increment of RAM addresses
S11
Reading operation data in RAM into non-volatile memory
S12
RAM address=CF?
NO
YES
S14
Other processing for power failure
Reset
Has power recovered ?
YES
NO
S15

FIG.8



Start
S1
Initialization
S2
Setting RAM address to "00"
S3
Reading operation data in non volatile memory into RAM
S4
RAM address = CF?
NO
S5
Increment of RAM addresses
YES
S6
Is data assigned to RAM address "CF" normal?
YES
NO
S7
RAM is cleared
S18
Is heating being performed ?
YES
NO
S19
Processing for interrupting operation
Displaying remaining period
Setting state that start key signal can be input
S20
S8
Main routine
S9
Has power failed?
NO
YES
S10
Setting RAM address to "00"
S11
Reading operation data in RAM into non-volatile memory
S12
RAM address = CF?
NO
S13
Increment of RAM addresses
YES
S14
Other processing for power failure
Reset
Has power recovered ?
YES
NO
S15

FIG.9

MICROWAVE OVEN AND HEATING COOKING APPLIANCE

This invention generally relates to microwave ovens of the type wherein a magnetron is oscillated by an inverter circuit and heating cooking appliances wherein an operation thereof is controlled by a microcomputer as a main control means.

In microwave ovens of the above-described type, an electric power supplied to the magnetron can be controlled to take a desirable value by varying an on-period of a switching element employed in the inverter circuit. Accordingly, the microwave ovens are advantageous in that an output power in the heating cooking can be varied in accordance with kinds of foods to be cooked. For the control of a magnetron output, input current detecting means is provided at the input side of the inverter circuit and the on-period of the switching element of the inverter circuit is varied with a current detection signal generated by the input current detecting means fed back to an inverter control circuit. More specifically, a microcomputer is incorporated in the inverter control circuit and supplied with the current detection signal representative of the value of current input to the inverter circuit. The microcomputer varies the on-period of the switching element so that the input current to the inverter circuit takes a predetermined value. For example, in heating at a rated output power, the microcomputer adjusts the on-period of the

switching element so that the on-period takes such a value that the rated current flows into the inverter circuit.

Input and output characteristics of the inverter circuit and the efficiency of the magnetron are previously determined at a design stage. Accordingly, in order that a predetermined magnetron output power is obtained, the inverter circuit may theoretically be feedback controlled so that the current corresponding to the magnetron output flows into the inverter circuit. However, the relationship between the current actually input to the inverter circuit and the magnitude of the current detection signal supplied to the microcomputer inevitably changes from product to product because of the variation in characteristic of the input current detecting means comprising a current transformer, current/voltage conversion circuit and A/D conversion circuit. For example, the value S_{IA} of the current detection signal in the case where a current of 10 amperes flows into the inverter circuit in one product usually differs from the value S_{IB} of the current detection signal in the case where the current of 10 amperes also flows into the inverter circuit in another product. Accordingly, when the microcomputers in these products are operated by the same software, the variation of the magnetron output of the magnetron is increased from product to product. Consequently, in some products, a proper cooking cannot be performed.

In order to overcome the above-described problem, a

partially fixed variable resistor has been conventionally provided in the input current detecting means. The variable resistor is adjusted after assembly of the products in the following manner. That is, the microwave oven is connected to the power supply and the magnetron is oscillated with the input current being measured. On the other hand, the microcomputer is supplied with a signal to control the inverter control circuit such that the magnetron is oscillated at the rated output. In the state of the rated output, the partially fixed variable resistor is turned with a tool such as a screwdriver so that the measured input current takes the rated input value corresponding to the rated output.

However, a circuit board on which the input current detecting means is mounted is generally disposed deep in the microwave oven and accordingly, the adjustment has some difficulty. The adjusting work is thus troublesome, which prevents the improvement of productivity.

The heating cooking appliance, for example, a microwave oven is provided with a bread baking function or rice cooking function as well as an ordinary oven function. Such a microwave oven needs a complicated control program and accordingly, a microcomputer is incorporated in the microwave oven to control the operation thereof with respect to the above functions. For example, in the oven function, a turntable motor and the magnetron are controlled by the microcomputer such that the microwave energy generated by

the magnetron is radiated onto food placed on a turntable with the turntable being turned, thereby executing the heating cooking. In this control manner, the microcomputer is provided with two control modes for the completion of the cooking, that is, a time limit control mode wherein a user sets a desirable completion time and a state control mode wherein a gas sensor is employed. In the state control mode, a gas density detection signal generated by the gas sensor is supplied to the microcomputer. The microcomputer performs the time limit control for the cooking completion at the time it determines that the gas density variation has reached a preselected value based on the gas density detection signal. In the bread baking function, a dough kneading motor is controlled and a heater or the like is controlled based on a temperature signal generated by a temperature sensor. The time limit control is performed for the completion time. The bread baking function includes an ordinary bread baking function wherein the operation is started immediately after the power is put to the microwave oven and a reserved bread baking function wherein the operation is started and completed at respective future times. Furthermore, in the rice cooking function, the microcomputer controls the magnetron and performs the time limit control for the cooking completion. The rice cooking function also includes an ordinary rice cooking function and a reserved rice cooking function as in the bread baking function.

When a power failure occurs in the commercial electric power supply connected to the above-described microcomputer, not only the microcomputer is stopped but also operation data stored in a RAM incorporated in the microcomputer is caused to be erased. Accordingly, the operation of the microwave oven, that is, the cooking needs to be done over again from the first when the power is recovered from the failure. In particular, where the power fails during the time counting operation of the microcomputer in the standby mode before start of the operation in the case of the reserved bread baking or rice cooking function, the time counting operation of the microcomputer is interrupted, which causes a problem that bread or rice has not been completely baked or cooked. To overcome such a drawback, the prior art has provided for backup batteries or an electrolytic capacitor of a large capacity for the purpose of preventing the microcomputer from being reset and the operation data in the RAM from being erased.

Although the operation of the microwave oven can be restarted since the operation data in the RAM can be held by provision of the backup battery or electrolytic capacitor, the production cost is increased. Furthermore, there is the possibility that the backup battery may be exhausted during the power failure and that the power supply cannot be held by the capacitor. Thus, the problem about the operation data holding has not been solved completely.

Therefore, a primary object of the present invention is

to provide a microwave oven wherein a work for adjusting the magnetron output after assembly can be simplified.

Another object of the invention is to provide a heating cooking appliance wherein the cost reduction can be enhanced and the operation data can be held more reliably.

The present invention provides a microwave oven comprising a cooking chamber, a magnetron generating microwave energy so that it is supplied into the cooking chamber, an inverter circuit supplying the magnetron with variable electric power and having a switching element, input current detecting means for detecting a current input to the inverter circuit, thereby generating a current detection signal representative of the detected input current, a non-volatile memory storing data representative of a signal level of the current detection signal generated by the input current detecting means when it is determined by a measurement that the input current to the inverter circuit takes a predetermined value, and an inverter control circuit feedback controlling the power supplied to the magnetron by varying an on-period of the switching element of the inverter circuit in accordance with the current detection signal generated by the input current detecting means and the data stored in the non-volatile memory such that the current detection signal takes a desirable value.

In accordance with the present invention, the magnetron is oscillated after assembly of the product with the input to the inverter circuit being measured. When it is

determined by measurement that the input to the inverter circuit has reached the predetermined value (a rated input value, for example), the data representative of the current detection signal generated by the input current measuring means at that time is stored in the non-volatile memory upon a data entry operation. Subsequently, the inverter control circuit operates the switching element of the inverter circuit based on the data (indicative of the signal level of the current detection signal when the rated input current flows) stored in the non-volatile memory and the actual current detection signal. Consequently, even when the relationship (proportional coefficient, for example) between the actual input current to the inverter circuit and the current detection signal supplied to the inverter control circuit then varies from product to product, the output of the inverter circuit is not affected by such a variation since the predetermined input is determined on the basis of the current detection signal at the time of the measurement of the predetermined input. For storing the data in the non-volatile memory, the magnetron is oscillated after the assembly with the inverter circuit input being measured and then, only the data entry operation is performed when the input reaches the predetermined value. Consequently, the adjustment work can be simplified as compared with the conventional microwave ovens in which the partially fixed variable resistor is adjusted with the screwdriver.

It is preferable that the non-volatile memory comprise

an electrically erasable/programmable read only memory (EEPROM). In this case, since the data to be stored may be electrically written into and erased from the memory, data entry and erasure can be performed with ease.

The invention may also be practiced by a microwave oven comprising an inverter control circuit obtaining a control constant from a measured input to the inverter circuit while the magnetron is being oscillated and the current detection signal generated by the input current detecting means while the magnetron is being oscillated. The inverter control circuit operates to cause data of the control constant obtained to be stored in the non-volatile memory. The inverter control circuit feedback controls the power supplied to the inverter circuit by varying an on-period of the switching element in accordance with the control constant, the data of which is stored in the non-volatile memory, such that the current detection signal generated by the input current detecting means takes the predetermined value.

In accordance with this arrangement, the inverter control circuit obtains the control constant from the measured input to the inverter circuit and the current detection signal generated by the input current detecting means at the time of measurement of the input to the inverter circuit. Different from the foregoing arrangements, the oscillation output of the magnetron may not be adjusted so that the input to the microwave oven

takes the predetermined value. Instead, the magnetron is oscillated at any output and then, the input measured at the time of oscillation of the magnetron is input to the inverter control circuit. This arrangement further enhances easiness of the adjustment work.

Furthermore, the invention may be practiced as a heating cooking appliance comprising main control means for controlling an operation of the appliance, the main control means having a random access memory (RAM) storing data of the operation of the appliance, power failure detecting means for detecting a power failure, a non-volatile memory, data input means for inputting data of the operation of the appliance stored in the RAM into the non-volatile memory when the power failure is detected by the power failure detecting means, operation restart control means for restarting the operation of the appliance based on the data of operation of the heating cooking appliance stored in the non-volatile memory when the main control means is started after recovery from the power failure.

When the power failure is detected by the power failure detecting means, the operation data stored in the RAM at the time of the power failure detection is entered into the non-volatile memory by the data entry means. Upon start of the main control means after recovery from the power failure, the operation of the heating cooking appliance is restarted based on the operation data stored in the non-volatile memory. Thus, after recovery from the power failure, the

operation of the appliance is restarted based on the data of operation at the time of occurrence of the power failure. Consequently, the operation need not be done over from the first. Furthermore, since the operation data is held by the non-volatile memory, the backup batteries or the electrolytic capacitors of a large capacity need not be employed, which reduces the cost of the products. Additionally, the operation data may be held reliably.

The following problem arises when the operation of the appliance is unconditionally started upon start of the main control means after recovery from the power failure. That is, where the operation of the appliance is in a sensor employed state control operation mode, it is likely that the state based on the information obtained by a sensor at the time of the power failure should largely differ from the actual state at the time of recovery from the power failure. Accordingly, when the operation of the appliance is started where the operation is in the sensor employed state control operation mode, the control manner can become unsuitable for the operation.

To overcome the above-described drawback, the invention provides another arrangement of the heating cooking appliance. In this arrangement, operation mode determining means is provided for determining whether or not the operation of the appliance at the time of the power failure is in the sensor used state control operation mode, when the main control means is started after recovery from the power

failure. The operation restart control means operates to restart the operation of the appliance based on the operation data stored in the non-volatile memory, while the restart of the operation of the appliance is prohibited when the operation of the appliance is in the sensor employed state control mode.

Upon start of the main control means, it is determined whether or not the operation of the appliance at the time of the power failure is in the sensor used state control mode. The operation of the appliance is restarted when it is determined that it is not in the sensor used state control mode. The restart of the operation of the appliance is prohibited when it is determined that the operation of the appliance is in the sensor used control operation mode. Consequently, the execution of the operation of the appliance can be canceled when there is an anxiety that the control manner tend to be unsuitable for the operation.

It is preferable that the heating cooking appliance comprise remaining time period displaying means for displaying a remaining time period necessary from the time of the midst of the heating to the completion of the heating, where the operation of the appliance is in the midst of the heating at the time of the occurrence of the power failure when the main control means is started after the recovery from the power failure. In this arrangement, the operation restart control means restarts the operation of the appliance based on the data of the operation stored

in the non-volatile memory when an operation is performed for starting the heating after the remaining time period is displayed by the remaining time period displaying means.

Where the power fails in the midst of the heating operation, the remaining time period necessary for completing the heating is displayed at the time of restart of the main control means after recovery from the power failure. In consideration of the remaining time period displayed and a period of power failure, the user can determine whether or not the operation be restarted based on the operation data stored in the non-volatile memory, whether or not the operation be done over again from the first, or whether or not the operation be stopped. Thus, the usability of the heating cooking appliance is enhanced.

The invention will be described, merely by way of example, with reference to the accompanying drawings, in which:

FIG. 1 shows an electrical circuit arrangement of a microwave oven of a first embodiment;

FIG. 2 is a flowchart for explaining the control manner of a microcomputer incorporated in the microwave oven;

FIG. 3 is a view similar to FIG. 2 showing a second embodiment of the invention;

FIG. 4 shows an electrical circuit arrangement of a microwave oven of a third embodiment of the invention;

FIGS. 5(a) to 5(f) illustrate waveforms at some circuit points shown in FIG. 4 and timings of writing and reading

operations of the microcomputer;

FIG. 6 is a flowchart for explaining the control manner of the microcomputer incorporated in the microwave oven;

FIG. 7 shows RAM addresses and an example of data storage;

FIG. 8 is a view similar to FIG. 6 showing a fourth embodiment of the invention: and

FIG. 9 is also a view similar to FIG. 6 showing a fifth embodiment.

A first embodiment of the present invention will be described with reference to FIGS. 1, 2 of the drawings. Referring to FIG. 1 showing an overall electric circuit arrangement of a microwave oven, a power supply plug 1 is to be connected to a commercial power source. A fuse 2, thermal switch 3, door switches 4 and 5, short-circuit switch 6, relay switch 7, fan motor 8, pilot lamp 9 and turntable motor 10 are connected to AC bus bars 1a and 1b as shown in FIG. 1. The door switches 4, 5 are switched off when a door (not shown) of the microwave oven is opened. Even when the door is opened during the heating cooking, the door switches 4, 5 are switched off such that the electric power is cut. The short-circuit switch 6 is switched on when the door is opened. Should the door switches 4, 5 be melted, a short circuit is made via the short-circuit switch 6 when the door is opened and the fuse 2 is melted to thereby break the circuit. The AC bus bars 1a, 1b are connected to an inverter circuit 11 to supply the same with

an AC power.

The inverter circuit 11 comprises a full-wave rectification circuit 12, choke coil 13, smoothing capacitor 14, primary winding 15a of a high-voltage transformer 15, resonance capacitor 16, damper diode 17 and switching element 18 constituted by an NPN transistor, as well known in the art. When the switching element 18 is switched on, a current having passed through the choke coil 13 flows into the primary winding 15a of the transformer 15 with its amount being increased such that magnetic energy is gradually stored in the primary winding 15a. When the switching element 18 is switched off, the stored magnetic energy causes a current to flow into the resonance capacitor 16 to be charged therein. Upon completion of the charging, the charged current is discharged into the primary winding 15a in the reverse direction until the switching element 18 is switched on again. Repetition of such electric charge and discharge causes an AC current to flow into the primary winding 15a of the transformer 15 such that an AC high voltage is induced in a secondary winding 15b of the transformer 15. A half-wave voltage doubler rectification circuit comprising a high-voltage capacitor 19 and high-voltage rectifiers 20 and 21 is connected to the secondary winding 15b. To a DC output line of the half-wave voltage rectification circuit is connected a magnetron 22 which generates microwave energy supplied into a cooking chamber (not shown). In the above-described arrangement, as an on-

period in one cycle of the switching element 18 is lengthened, an amount of the magnetic energy stored in the primary winding 15a of the transformer 15 is increased, thereby increasing an output of the inverter circuit 11 and therefore, oscillation output (heating output) of the magnetron 22.

The on-off timing of the switching element 18 is controlled by an inverter control circuit 25 incorporating a microcomputer 23 and base control circuit 24 such that the magnetron 22 is oscillated at a predetermined output. In a manual mode, a user manipulates a heating intensity setting key and a heating period setting key provided in an operation section 26 provided on the front of the microwave oven so that the oscillation output of the magnetron 22 and the heating period are set to desirable values, respectively. In an automatic cooking mode, the oscillation output of the magnetron 22 and the heating period are automatically set by the microcomputer in accordance with the weight of food measured by a weight sensor (not shown). It is previously known that input and output characteristics of the inverter circuit 11 and the efficiency of the magnetron 22 take respective fixed values. Accordingly, in order that the magnetron 22 is oscillated at the preselected output, the output of the magnetron 22 is not directly measured but the following feedback control is performed. That is, the input current flowing into the inverter circuit 11 is measured and data of the measured input current value

is fed back to the microcomputer 23. The microcomputer 23 determines the on-period of the switching element 18 of the inverter circuit 11 so that the input current takes a value in accordance with a preselected output of the magnetron.

For the purpose of performing the above-described feedback control, input current detecting means 27 is provided for detecting the input current to the inverter circuit 11 to generate a current detection signal representative of the value of the current detected and, also, a non-volatile memory 28 is provided so as to be accessed by the microcomputer 23. The non-volatile memory 28 is comprised of, for example, an electrically erasable/programmable read only memory (EEPROM) wherein data can be electrically written and erased repeatedly. The data stored in the non-volatile memory 28 is preserved even when the power supply is cut. The input current detecting means 27 comprises a current transformer 29 provided on the AC bus bar 1b as the input side of the inverter circuit 11 and a current/voltage conversion circuit 30. The input current detecting means 27 supplies the microcomputer 23 with a current detection signal S_I, the level of which is proportional to the value of current flowing through the AC bus bar 1b. Based on the current detection signal S_I supplied from the input current detecting means 27 and the data stored in the non-volatile memory 28, the microcomputer 23 supplies the base control circuit 24 with a control signal so that the switching element 18 is switched on for a

necessary on-period. More specifically, in the non-volatile memory 28 is previously written data indicative of the signal level of the current detection signal S_I generated by the input current detecting means 27 at the time a rated input current flows through the AC bus bar 1b, as will be described later. When a command that the magnetron 22 be oscillated at the rated output is entered into the microcomputer 23, it accesses the non-volatile memory 28 to input the data of the signal level therefrom. The microcomputer 23 then compares the input data of the signal level with the level of the current detection signal S_I generated by the input current detecting means 27. Where the former is lower than the latter, the on-period of the switching element 18 is lengthened while it is shortened where the former is higher than the latter. Thus, the on-period of the switching element 18 is so determined that the signal level of the current detection signal S_I becomes equal to the signal level indicated by the input data. Consequently, the input current to the inverter circuit 11 takes the rated value, that is, the on-period of the switching element 18 is so determined that the oscillation output (heating output) of the magnetron 22 takes the rated value. Furthermore, when a command that the magnetron 22 be oscillated at 70% of the rated output is entered into the microcomputer 23, it likewise accesses the non-volatile memory 28 to input the data of the signal level therefrom. The microcomputer 23 operates to multiply the value of the

signal level indicated by the input data by 0.7 and then compare an obtained value (the value equal to 70% of the signal level of the input data) with the level of the current detection signal S_I generated by the input current detecting means 27. The on-period of the switching element 18 is so determined that the level of the current detection signal S_I takes the value equal to 70% of the the signal level indicated by the input data. Consequently, the input current to the inverter circuit 11 takes the value equal to 70% of the rated input current and the magnetron 22 is oscillated at the value equal to 70% of the rated output.

The above-described data input operation of the microcomputer 23 from the non-volatile memory 28 is executed as an adjustment work after assembly of the products. For this purpose, a writing program such as shown in FIG. 2 is previously entered in the microcomputer 23. The procedure of the adjustment work and the writing program will be described below. An AC ammeter is employed to execute the adjustment work for the microwave oven of the embodiment. The power supply plug 1 is connected to the power source and a suitable dummy load is placed in the cooking chamber in the condition that the input currents to the AC bus bars 1a, 1b are measurable. When the power is put to the microwave oven in this condition, the microcomputer 23 checks the writing already done in the non-volatile memory 28 at a step A1. Since the writing has not been made yet immediately after the assembly of the product, the microcomputer 23

advances to a step A2 where it is determined whether or not an operation for setting an adjustment mode is performed. When a previously defined operation is executed for setting the adjustment mode, the microcomputer 23 operates to drive the inverter circuit 11 to oscillate the magnetron 23, at a step A3. The adjustment mode setting operation is defined as a simultaneous operation of two of the keys of the operation section 26, which combination of the two switches is never encountered in the operation for an ordinary use.

Upon oscillation of the magnetron 22, the operator views the ammeter to check the value of the input current. When the ammeter occasionally indicates the rated input current value, the operator performs the previously defined writing operation at the operation section 26. The writing operation here is likewise defined as the simultaneous operation of two of the keys of the operation section 26. When the writing operation is executed, it is determined at a step A4 that the data input operation has been performed, the microcomputer 23 advances to a step A5 where the data of then signal level of the current detection signal S_I generated by the input current detecting means 27 at that moment is entered into the non-volatile memory 28. The signal level indicated by the data corresponds to that of the current detection signal S_I when the rated input current flows into the inverter circuit 11.

Where the input current to the inverter circuit 11 does not take the rated input current value when the magnetron 22

starts its oscillation, the operator performs a previously defined output adjustment operation at the operation section 26 so that the output of the magnetron 22 is adjusted such that the actual input current to the inverter circuit 11 takes the rated input current value. The output adjustment operation here is defined as the simultaneous operation of one of temperature adjustment buttons for the grill cooking and a start key. When a temperature increasing button and the start key are simultaneously depressed, the microcomputer 23 operates to lengthen the on-period of the switching element 18 of the inverter circuit 11 so that the oscillation output of the magnetron 22 is increased. On the other hand, when a temperature decreasing button and the start key are simultaneously depressed, the on-period of the switching element 18 is shortened, thereby decreasing the oscillation output of the magnetron 22 (steps A6, A7). Subsequently, when the magnetron 22 output is adjusted so that the actual input current to the inverter circuit 11 takes the rated input current value, the operator executes the above-described writing operation at the operation section 26, whereby the microcomputer 23 advances to the step A5 where the data of then signal level of the current detection signal S_I generated by the input current detecting means 27 at that moment is input into the non-volatile memory 28, thereby completing the adjustment work.

The microcomputer 23 executes the above-described ordinary feedback control for the inverter circuit 11 based

on the data stored in the non-volatile memory 28 and the current detection signals S_I generated during the operation of the microwave oven, upon operation for the ordinary heating in the condition that the data of then signal level of the current detection signal S_I generated at the time the rated input current flows into the inverter circuit 11 has been stored in the non-volatile memory 28. In the above-described condition, the feedback control is executed upon the operation for the ordinary heating unless the adjustment mode setting operation is performed (step A8).

In accordance with the above-described embodiment, the adjustment work for the magnetron 22 output may be executed by making use of some particular keys of the operation section 26 mounted at the front of the microwave oven with the input current to the microwave oven being measured. Consequently, the adjustment work may be simplified as compared with that in the prior art wherein the partially fixed variable resistor on the circuit board in the microwave oven needs to be operated.

A second embodiment of the invention will now be described with reference to FIG. 3. A so-called hardware arrangement in the second embodiment is the same as in the foregoing embodiment. The second embodiment differs from the foregoing embodiment in a so-called software arrangement for the microcomputer 23 of the inverter control circuit 25. In the second embodiment, the microcomputer 23 comprises means for obtaining a control constant from the actually

measured input to the inverter circuit 11 at the time of oscillation of the magnetron 22 and the current detection signal S_I generated by the input current detecting means 27 at that time, means for causing data of the obtained control constant to be stored in the non-volatile memory 28, and means for feedback controlling the power supplied to the magnetron 22 on the basis of the control constant stored in the non-volatile memory 28. FIG. 3 shows an outline of the software and the procedure of the adjustment work and a program therefor will be described below.

As in the foregoing embodiment, the power supply plug 1 is connected to the power source and a dummy load is placed in the cooking chamber in the condition that the input currents to the bus bars 1a, 1b can be measured by making use of the AC ammeter or the like. When the power is put to the microwave oven in this condition, the microcomputer 23 determines whether or not the data input into the non-volatile memory 28 has already been performed (step B1). Since the data input into the non-volatile memory 28 is not been performed immediately after assembly of the product, the microcomputer 23 advances to a step B2 where it is determined whether or not the adjustment mode setting operation has been performed. When the previously defined adjustment mode setting operation is executed, the inverter circuit 11 is driven so that the magnetron 22 is oscillated (step B3). The adjustment mode setting operation here is defined as the simultaneous operation of two of keys of the

operation section 26, which combination of the two keys is never encountered in the ordinary use of the microwave oven, as in the foregoing embodiment. Upon oscillation of the magnetron 22, the operator views the ammeter to check the value of the input current. The operator enters data of the input current value into the microcomputer 23 at the operation section 26. The microcomputer 23 is programmed for the entry of data of the input current value as follows: when the temperature increasing button and the start key, for example, are simultaneously depressed, a numerical value displayed on a numerical display section of the display 31 provided on the front of the microwave oven is gradually increased. When the temperature decreasing button and the start key are simultaneously depressed, the numerical value displayed on the numerical display section is gradually decreased. The numerical display section of the display 31 is originally provided for displaying the cooking period and the current time. When another particular button is depressed, data of the numerical value displayed then is definitely entered. When the data of the numerical value (the measured input to the inverter circuit 11) is thus entered, the microcomputer 23 fetches the data (step B4) and obtains the control constant and the maximum input from the data fetched and the current detection signal S_I generated by the input current detecting means 27 at the time the input to the inverter circuit 11 is measured (step B5). The control constant represents a proportional constant between

the measured input current to the inverter circuit 11 and the signal level of the current detection signal S_I generated at the time of measurement of the input current to the inverter circuit 11. The maximum input represents the input current corresponding to the maximum rating of the microwave oven. The data of these values is immediately entered into the non-volatile memory 28 (step B6). Subsequently, when the usual manipulation for the heating is performed, the microcomputer 23 executes control over the inverter circuit 11 by way of the usual feedback control in accordance with the data of the control constant stored in the non-volatile memory 28 unless the adjustment mode setting operation is performed (step B7).

The feedback control is executed as follows. Upon receipt of a command that the magnetron 22 should be oscillated at the rated output, the microcomputer 23 accesses the non-volatile memory 28 to read out the data of the control constant stored therein. The microcomputer 23 obtains the value of the actual input current to the inverter circuit 11 by multiplying each of the values of the current detection signals S_I sequentially generated by the input current detecting means 27 by the control constant. The microcomputer 23 then compares the input current value obtained with the rated input current value. When the former is smaller than the latter, the on-period of the switching element 18 is lengthened while it is shortened when the former is larger than the latter. The

microcomputer 23 thus determines the on-period of the switching element 18 so that the input current value obtained becomes equal to the rated input current value. Consequently, the on-period of the switching element 18 is determined so that the input current to the inverter circuit 11 takes the rated value, that is, the oscillation output (heating output) of the magnetron 22 takes the rated value. On the other hand, when the microcomputer 23 receives the command that the magnetron 22 be oscillated at 70% of the rated output, the non-volatile memory 28 is also accessed so that the data of the control constant is read out. The microcomputer 23 obtains the value of the actual input current to the inverter circuit 11 by multiplying the current value of the current detection signal S_I by the control constant as in the same manner as described above. The microcomputer 23 then compares the input current value obtained with 70% of the rated input current, whereby the on-period of the switching element 18 is determined so that the input current obtained becomes equal to 70% of the rated input current, as in the same manner as described above. Consequently, the input current to the inverter circuit 11 takes the value 70% of the rated input current and accordingly, the magnetron 22 is oscillated at 70% of the rated input current. Furthermore, the microcomputer 23 determines the on-period of the switching element 18 so that the value of the input current to the inverter circuit 11 does not exceed the maximum input value, the data of which

is stored in the non-volatile memory 28.

In the second embodiment, too, the operator can do the adjustment work with the keys of the operation section 26 provided on the front of the microwave oven, measuring the input current to the microwave oven with the ammeter. Consequently, the adjustment work may be simplified as compared with the prior art wherein the partially fixed variable resistor on the circuit board disposed deep in the microwave oven needs to be operated. Furthermore, different from the arrangement of the first embodiment, the magnetron 22 may be oscillated at any output without adjustment of the oscillation output so that the microwave oven input takes a predetermined value such as the rated input. The data of the input measured at the time the magnetron 22 is oscillated at said any output is entered into the microcomputer 23. Thus, the adjustment work may be further simplified.

A third embodiment of the invention will be described with reference to FIGS. 4 to 7. FIG. 4 illustrates an electric circuit diagram of the microwave oven of the type that has bread baking and rice cooking functions. The fuse 42, thermal switch 43, door switches 44 and 45, relay switch 46, primary winding 47a of the high-voltage transformer 47 and fixed contact a and moving contact c of the switching type relay switch 48 are connected between the terminals 41a and 41b of the power supply plug 41 to be connected to the commercial power source. A primary winding 49a of a step-

down transformer 49 and a series circuit of a relay switch 50 and a pilot lamp 51 are parallel connected between a power side terminal of the door switch 44 and the terminal 41b of the power supply plug 41. A forward rotation relay switch 52, reverse rotation relay switch 53 and dough kneading motor 54 are connected between the power side terminal of the relay switch 46 and the moving contact c of the relay switch 48, as shown in the drawings. A relay 55, cooling fan motor 56 and turntable motor 57 are also connected as shown in the drawings. Furthermore, a series circuit of a relay switch 58 and a hot blast motor 59 and another series circuit of a relay switch 60 and a hot blast motor 61 are parallel connected between the power side contact of the relay switch 46 and the fixed contact b of the relay switch 48. A grill heater 62 is connected between an opposite power side terminal of the relay switch 46 and the fixed contact b of the relay switch 48. A half-wave voltage doubler rectification circuit 63 and magnetron 64 are connected to a secondary winding 47b of the high-voltage transformer 47.

A control circuit 65 comprises a power failure compensation circuit. A rectification circuit 66 is connected to the secondary winding 49b of the transformer 49. A stabilized power supply circuit 68 is connected through a smoothing capacitor 67 to a center tap of the secondary winding 49b. The stabilized power supply circuit 68 supplies each of the circuits such as a microcomputer 69

with an operating power supply voltage V_{cc} (+5 V). This operating power supply is supplied to a reset circuit 70 and a reset signal is supplied to the microcomputer 69 from the reset circuit 70. A timer base circuit 71 shapes waves of a half-wave signal Sc (see FIG. 5(b)) synchronous with the frequency of a commercial AC input (see FIG. 5(a)) to thereby obtain a synchronous pulse Pc (see FIG. 5(c)) which is supplied to the microcomputer 69. To the microcomputer 69 are supplied switch inputs from a switch input circuit 72 comprising various switches, signals from weight sensor 73, gas density sensor 74 and temperature sensor 75 respectively. In accordance with an operation program whose data is stored in a ROM incorporated therein, the microcomputer 69 controls a relay drive circuit 76, display circuit 77 to control the operation of the microwave oven and furthermore, writes data into a non-volatile memory 78 and reads it out therefrom as will be described later. The relay drive circuit 76 controls the switches 46, 48, 50, 52, 53, 55, 58 and 60 based on the control signal from the microcomputer 69. The non-volatile memory 78 comprises the electrically erasable/programmable read only memory (EEPROM) and the data stored therein can be held even when the operation power supply voltage V_{cc} drops to 0 volts.

The microwave oven of the third embodiment is provided with the microwave oven function, bread baking function and rice cooking function. Each function will be described in brief. In the microwave oven function, the turntable motor

57 and magnetron 64 are controlled by the microcomputer 69 such that the microwave energy generated by the magnetron 64 is radiated onto the food placed on the turntable (not shown) with the turntable being turned, thereby performing the heating cooking. The cooking completion time may be controlled either in a time-limit control wherein the cooking completion time is set by the user or in a state control mode based on the signal from the gas sensor 74. In the state control, the gas density signal is supplied from the gas sensor 74 to the microcomputer 69, which executes the time-limit control for the cooking completion at the time the gas density variation reaches a predetermined value based on the gas density signals. The time-limit control may also be set in accordance with the weight signal from the weight sensor 73. In the bread baking function, the dough kneading motor 54 is controlled and the hot blast heater 61 or the like is controlled in accordance with the signal from the temperature sensor 75 and the time-limit control is performed for the cooking completion. The bread baking function has an ordinary bread baking function wherein the bread baking is initiated immediately after setting and a reserved bread baking function wherein the bread baking is initiated at a set future time and completed at a desirable time. Furthermore, in the rice cooking function, the magnetron 64 is controlled by the microcomputer 69 and the time-limit control is performed for the cooking completion. The rice cooking function also has

an ordinary rice cooking function and a reserved rice cooking function, as in the bread baking function. The time-limit control in each of the above-described cooking functions is performed by counting synchronous pulses P_C input to the microcomputer 69.

Power failure compensation means is comprised of the above-described software arrangement of the microcomputer 69 and the foregoing timer base circuit 71. The microcomputer 69 serves as main control means having a RAM, data input means and operation restarting means. The function of each above-described means will be described with reference to FIG. 6.

Upon start of the microcomputer 69 after recovery from the power failure, the microcomputer 69 executes steps from step S1 and so on. A step S8, however, will be described for the purpose of easily understanding the invention. In the main routine of the step S8, the heating cooking is controlled based on any one of the range, bread baking and rice cooking functions. It is determined whether or not a power failure has occurred at a step S9. More specifically, the microcomputer 69 determines whether or not the pulses Pc of the continuous two cycles are input. Where the continuous two cycles of pulses P_C are not input, the occurrence of the power failure is detected. For example, when the power failure occurs at time t_0 in FIG. 5, t_1 represents the time it is detected. Then, upon detection of the occurrence of the power failure, the operation data

stored in the RAM of the microcomputer 69 at the current time is entered into the non-volatile memory 78. FIG. 7 shows the relationship between addresses and the stored data in the RAM. For example, at the address "00" is stored data of the kind of the current operation, for example, any one of the time display, rice cooking reservation, bread baking reservation and range cooking. Addresses "01" to "06" are allotted for time data, addresses "07" to "0C" for remaining operation period data, and addresses "0D" to "10" for data of desirable operation completion time. The address "CF" is particularly allotted for storing, after the occurrence of the power failure, the check data which is used to determine whether or not the last data entry into the non-volatile memory 78 is normal.

In entering the operation data into the non-volatile memory 78, the address "00" is set in the RAM at a step S10 and the data allotted to the address is entered into the non-volatile memory 78 at a step S11. At a step S12, it is determined whether or not the RAM is set to the address "CF" (the last address in the data area). When the RAM is not set to the address "CF," increment of the RAM addresses is executed at a step S13 and data of the increased address is entered into the non-volatile memory 78. The operation data stored in the RAM is sequentially entered into the non-volatile memory 78. Upon completion of the data entry, other processes for the power failure are performed at a step S14. It is then determined whether or not the recovery

from the power failure has been made. This determination is made on a standpoint that it is preferable to continue the operation, because the recovery from the power failure may be made during entry of the data into the non-volatile memory 78. The detection of the recovery from the power failure relies upon whether or not the synchronous pulses Pc are input. When determining that the recovery from the power failure has been made, the microcomputer 69 returns to the main routine. When the power failure occurs at time t_0 in FIG. 5 and continues, output of the reset signals from the reset circuit 70 is stopped (see FIG. 5 (e)) and accordingly, the operation holding voltage drops (see FIG. 5(d)), which stops the microcomputer 69. The time constants of the reset circuit 70 and stabilized power supply circuit 68 are determined so that the above-described data entry into the non-volatile memory 78 is completed within a period from the time of detection of the power failure to the stop of output of the reset signals.

Although the microcomputer 69 is stopped and the data stored in the RAM is erased in the power failure, the operation data at the time of the occurrence of the power failure is stored in the non-volatile memory 78. Thereafter, when the power is recovered, the microcomputer 69 is supplied with the operating voltage V_{cc} to be started at the time t_2 in FIG. 5 and the control thereof is initiated. First, an initialization is performed at the step S1. The address of the RAM is set to "00" at the step

S2 and the data stored in the non-volatile memory 78 (operation data) is read out and entered into the RAM at the step S3. At the step S4, it is determined whether or not the RAM is set to the address "CF" (the last address in the data area). When it is determined that the RAM is not to the address "CF," the increment of the RAM addresses is executed and the data stored in the non-volatile memory 78 is entered into the RAM at the address increased at the step S5. Thus, the operation data stored in the non-volatile memory 78 is sequentially read out and entered into the RAM. Upon completion of the data entry, it is determined whether or not the data allotted to the address "CF" is normal. When it is determined that the data is normal or the data entry is normally performed at the time of the occurrence of the power failure, the microcomputer 69 returns to the main routine at the step S8. The operation of the microwave oven is restarted in accordance with the operation data entered into the RAM in the main routine. When it is determined that the data is not normal, the RAM is cleared at the step S7.

According to the above-described embodiment, the operation of the microwave oven is restarted in accordance with the operation data at the time the power failure occurred when the power failed and recovered. Consequently, the operation of the microwave oven need not be done over again from the start. Furthermore, since the operation data is held by the non-volatile memory during the power failure,

the microwave oven of the invention is cost effective as compared with those of the prior art in which the backup batteries or electrolytic capacitors of large capacity are employed for holding the operation data and the holding of the operation data may be done more reliably.

FIG. 8 illustrates a fourth embodiment of the invention. The fourth embodiment differs from the third embodiment in the operation restart means of the microcomputer 69 and in additional provision of operation mode determining means. More specifically, the fourth embodiment differs from the third embodiment in the steps S16 and S17. That is, even when the operation data is entered into the RAM and the operation data is normal from the step S1 to the step S6, the microcomputer 69 does not return to the main routine immediately at the step S8. In the step S6, it is determined whether the operation of the microwave oven at the time of occurrence of the power failure is in a state control operation mode by use of the gas density sensor 74 and temperature sensor 75. Whether or not the operation of the microwave oven is in the state control operation mode relies upon the operation data entered into the non-volatile memory at the time of occurrence of the power failure. When it is determined that the operation of the microwave oven is not in the state control operation mode, the operation is restarted. However, when it is determined that the operation is in the state control operation mode, a processing for interrupting

the operation is performed at the step S17 and then, the microcomputer 69 advances to the step S8. In this case, the operation is not restarted in the main routine because of the execution of the operation interruption processing.

When there is an anxiety that the control manner in which the operation of the microwave oven is controlled become unsuitable therefor as the result of the power failure, the execution of the operation may be canceled. More specifically, when the operation of the microwave oven is in the sensor used state control operation mode at the time of the occurrence of the power failure, it is likely that the state based on the information sensed by the sensors at the time of the occurrence of the power failure largely differs from the actual state when the power is recovered. Accordingly, when the operation which is in the state control operation mode is unconditionally restarted after the power recovery, the control manner tends to be unsuitable for the operation. In accordance with the fourth embodiment, however, the operation of the microwave oven is restarted after power recovery based on the operation data stored in the non-volatile memory 78 when the operation at the time of occurrence of power failure is not in the state control operation mode. On the other hand, the operation of the microwave oven is not restarted when the operation is in the state control operation mode at the time of occurrence of power failure. Consequently, the operation of the microwave oven may be interrupted when there is an anxiety

that the control manner tend to be unsuitable for the operation. Furthermore, since the operation data is held by the non-volatile memory during the power failure, the microwave oven of the invention is cost effective as compared with those of the prior art in which the backup batteries or electrolytic capacitors of large capacity are employed for holding the operation data and the operation data may be held more reliably.

In the third and fourth embodiments, the data stored in the non-volatile memory is entered into the RAM and the operation is restarted based on the data entered into the RAM when the microcomputer is started upon the power recovery from failure. However, the microcomputer may directly access the non-volatile memory and the operation of the microwave oven may be controlled based on the operation data stored in the non-volatile memory without entry of the data in the non-volatile memory into the RAM.

FIG. 9 illustrates a fifth embodiment. The operation restarting means in the microcomputer 69 differs from that in the third embodiment and remaining period display means comprised of the microcomputer 69 and the display circuit 77 is provided in the fifth embodiment. More specifically, the steps S18 to S20 in FIG. 9 differ from those in the third embodiment. That is, the microcomputer 69 returns to the main routine to restart the operation when data entry into the RAM is completed and the data entered is normal, in the third embodiment. In the fifth embodiment, however, it is

determined whether or not the heating was being performed at the time of occurrence of the power failure at the step S18. The determination is based on the operation data entered into the non-volatile memory 78 at the time of occurrence of the power failure. When it is determined that the heating was being performed at the time of occurrence of the power failure, the processing for interrupting the operation of the microwave oven is performed and a remaining period necessary for completing the heating is displayed on the remaining period display means. The microcomputer 69 advances to the step S8 after the microwave oven is set in the state that the heating can be started. In this case, when the start key is operated in the main routine, the operation is restarted and the heating is executed for the period equal to the remaining period displayed.

According to the fifth embodiment, in the case where the heating is being performed at the time of occurrence of the power failure, the remaining period necessary for completion of the heating is displayed on the remaining period display means when the microcomputer is started after recovery from the power failure. Taking into account the remaining period and the actual period of the power failure, the user may determine whether or not the operation should be restarted based on the operation data stored in the non-volatile memory 78, whether or not the operation should be done over again, or whether or not the operation should be stopped. Consequently, the usability of the microwave oven

is improved. Furthermore, since the operation data is also held by the non-volatile memory during the power failure, the microwave oven of the invention is cost effective as compared with those of the prior art in which the backup batteries or electrolytic capacitors of large capacity are employed for holding the operation data and the operation data may be held more reliably.

The foregoing disclosure and drawings are merely illustrative of the principles of the present invention and are not to be interpreted in a limiting sense. The only limitation should be determined from the scope of the appended claims.

WE CLAIM:

1. A microwave oven comprising:

a) a cooking chamber;

b) a magnetron generating microwave energy so that it is supplied into the cooking chamber;

c) an inverter circuit supplying the magnetron with variable electric power and having a switching element;

d) input current detecting means for detecting a current input to the inverter circuit, thereby generating a current detection signal representative of the detected input current;

e) a non-volatile memory storing data representative of a signal level of the current detection signal generated by the input current detecting means when it is determined by a measurement that the input current to the inverter circuit takes a predetermined value; and

f) an inverter control circuit feedback controlling the power supplied to the magnetron by varying an on-period of the switching element of the inverter circuit in accordance with the current detection signal generated by the input current detecting means and the data stored in the non-volatile memory such that the current detection signal takes a desirable value.

2. A microwave oven according to claim 1, wherein the non-volatile memory comprises an electrically

erasable/programmable read only memory (EEPROM).

3. A microwave oven comprising:

a) a cooking chamber;

b) a magnetron generating microwave energy so that it is supplied into the cooking chamber;

c) an inverter circuit supplying the magnetron with variable electric power and having a switching element;

d) input current detecting means for detecting a current input to the inverter circuit, thereby generating a current detection signal representative of the detected input current;

e) a non-volatile memory; and

f) an inverter control circuit obtaining a control constant from a measured input to the inverter circuit while the magnetron is being oscillated and the current detection signal generated by the input current detecting means while the magnetron is being oscillated, the inverter control circuit operating to cause data of the control constant obtained to be stored in the non-volatile memory, the inverter control circuit feedback controlling the power supplied to the inverter circuit by varying an on-period of the switching element in accordance with the control constant, the data of which is stored in the non-volatile memory, such that the current detection signal generated by the input current detecting means takes the predetermined value.

4. A heating cooking appliance comprising:

a) main control means for controlling an operation of the heating cooking appliance, the main control means having a random access memory (RAM) storing data of the operation of the heating cooking appliance;

b) power failure detecting means for detecting a power failure;

c) a non-volatile memory;

d) data input means for inputting data of the operation of the heating cooking appliance stored in the RAM into the non-volatile memory when the power failure is detected by the power failure detecting means;

e) operation restart control means for restarting the operation of the heating cooking appliance based on the data of operation of the heating cooking appliance stored in the non-volatile memory when the main control means is started after recovery from the power failure.

5. A heating cooking appliance according to claim 4, which further comprises operation mode determining means for determining whether or not the heating cooking appliance is in a sensor-used state control operation mode at the time of occurrence of the power failure, when the main control means is started after the recovery from the power failure, the operation of the heating cooking appliance being restarted by the operation restart control means based on the data of operation of the appliance stored in the non-volatile memory

when the operation mode determining means determines that the appliance has not been in the sensor-used state control operation mode, the restart of the operation of the appliance being prohibited when the appliance is in the sensor-used state control operation mode at the time of the occurrence of the power failure.

6. A heating cooking appliance according to claim 4, which further comprises remaining time period displaying means for displaying a remaining time period necessary from the time of the midst of a heating operation to the completion thereof when the main control means is started after the recovery of the power failure, where the operation of the appliance is in the midst of the heating operation at the time of the occurrence of the power failure, the operation restart control means restarting the operation of the appliance based on the data of the operation stored in the non-volatile memory when an operation is performed for starting the heating after the remaining time period is displayed by the remaining time period displaying means.

7. A microwave oven and heating cooking appliance substantially as herein described with reference to the accompanying drawings.

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